

REMARKS

Claims 1-20 remain in the application. Claims 16-20 have been withdrawn from consideration. Claims 1-11, 13 and 14 are rejected. Claim 12 is objected to. Claim 15 is allowed. Claim 1 has been amended as shown. Claim 4 has been canceled. The applicant submits the following remarks and hereby requests reconsideration of the rejections.

A. Examiner's Rejections Under 35 USC § 102

1. Claims 1, 3-10 and 14

The Examiner's rejection of Claims 1, 3-10 and 14 under 35 U.S.C. 102(e) as being anticipated by James et al. (U.S. Patent 6,926,970) is respectfully traversed.

A reference anticipates a claimed invention when the reference teaches "every aspect of the claimed invention, either explicitly or impliedly." MPEP 706.02. When a cited reference does not explicitly or impliedly teach a feature, that feature must be inherently present in the cited reference in order to anticipate the claimed invention. MPEP 706.02. Applicant contends that James et al. does not teach or otherwise contain all the limitations of Claims 1,3-10 and 14.

With respect to Claim 1, the applicant submits that James et al. does not teach, either expressly or impliedly, every aspect of Claim 1 of the subject application. More specifically, James et al. does not contain any teaching directed to "performing a second operation to induce more shallow compressive residual stresses along a portion of the surface of a part."

Claim 1, as amended, provides:

“A method of inducing residual compressive stresses in the surface of a part comprising the steps of:
in a single pass,
performing a first operation to induce deep compressive surface stresses along a portion of the surface of the part; and
performing a second operation to induce a more shallow compressive surface stresses along a portion of the surface of the part.”

The Examiner takes the position that James et al. teaches performing a first operation to induce deep compressive surface stresses along a portion of the surface of the part; and performing a second operation to induce more shallow compressive surface stresses along a portion of the surface of the part, citing col. 8, line 50; col. 9, line 15; col 11, lines 37 - 40; col. 11, line 60; col. 12, line 2; and col. 55, lines 55 - 62.

The Applicant submits that the welding apparatus 100 of James et al. discloses a compression tool 106 for producing a layer of residual compressive stress along the surface of the weld joint 28 and may further include a cutting tool 115 “structured to remove flash from the weld joint 28 and the surface of the workpiece 12 adjacent to the weld joint to thereby provide a structural assembly 112 having a relatively smooth finished surface.” (Col. 8, lines 50 - 67, col. 9, line 5 - 14, emphasis added).

Accordingly, the second operation of James et al. identified by the Examiner is used to **remove flash** produced by the welding operation and does not teach performing an operation to induce a more shallow compressive surface stresses. Indeed, James et al. does not even teach the removal of a layer of the surface for placing already induced surface stresses closer to the resulting upper surface of the part.

The subject invention is directed to a method and apparatus for improving the magnitude and penetration of compressive residual stresses induced in a part and, more particularly, improving the magnitude of compressive residual stress at the upper most

surface of the part. The present invention also alleviates the need for an additional, different operation by providing a methodology for inducing a first, deep layer of compressive residual stress and a second, more shallow layer of compressive residual stress utilizing one surface treatment technique such as burnishing. In contrast, James et al. is directed to inducing a single, deep layer of compressive residual stress in a weld joint.

The James et al. reference does not teach the limitation of performing a secondary operation to induce a second, more shallow layer of compressive residual stress. Instead, as stated at column 11, lines 37-40, James et al. is directed to performing a burnishing operation "in a single pass or in multiple passes" of one single point tool to produce "*deep compression* with minimal cold working." According to James et al., the first burnishing operation, and any subsequent burnishing operations, are meant to improve the depth to which induced compressive residual stresses extend *beneath* the surface of a part and not to induce *more shallow* compressive surface stresses as is claimed in the subject invention. Therefore, the subject invention is patentably distinguishable from the prior art as it addresses the problem of providing a *more shallow* compressive surface stress rather than deeper compressive residual stresses.

In addition, James et al. does not teach, either expressly or impliedly, performing multiple surface treatment operations "performed in a single pass of the apparatus" as taught in Claim 4 of the subject application. Figs. 3 and 4 of James et al. only show a surface treatment apparatus with a single compression tool 106, specifically a single-point burnishing tool 107. Further, James et al. does not contain any discussion or illustration of an apparatus with multiple compression tools such as those shown at Figs.

1 and 3 of the subject invention. As such, if James et al. taught performing a first operation to induce deep compressive surface stresses and a second operation to induce more shallow compressive surface stresses, which it does not, it would require applying the apparatus of James et al. in multiple passes as opposed to the single-pass capabilities of the apparatus of the present invention. Therefore, Applicant's Claim 1 is patentably distinguishable over James et al.

With regard to Claims 3-10 collectively, any claim that depends from an allowed claim may also be allowed. See *Ex parte Ligh*, 159 USPQ 61, 62 (Bd. of Pat. App. & Inter. 1967). Therefore, provided that the Examiner has found persuasive Applicant's arguments in traverse of the rejection of Claim 1, the Applicant respectfully submits that Claims 3-10, which depend from Claim 1, are in proper condition for allowance and requests favorable reconsideration of these Claims.

As noted above with respect to Claim 1, James et al. does not teach performing a second operation to induce *more shallow* compressive surface stresses. Therefore James et al. does not anticipate the additional limitation of performing the second operation in multiple passes, as disclosed in Claim 3 of the subject invention.

With respect to Claim 5, James et al. does not teach the limitations of performing a first operation to induce deep compressive surface stresses and performing a second operation to induce more shallow compressive surface stresses. As such, James et al. does not anticipate the additional limitation of the first and second operations being performed with single point burnishing members, as set out in Claim 5.

With respect to Claim 6, the Applicant submits that the cited reference, James et al., does not teach, either expressly or impliedly, the limitation of the temperature of the

surface of the part during the first operation is of a first temperature and the temperature of the surface of the part during the second operation is of a second different temperature. Of the various references cited by the Examiner in rejecting Claim 6, only col. 11, line 60 – col. 12, line 2 of James et al. makes specific reference to temperature. Contrary to the Examiner's assertion, the reference to temperature at col. 11, line 60 – col. 12, line 2 does not teach or suggest performing a second operation at a second temperature, but is instead a reference to the physical properties possessed by a part burnished at one temperature and *exposed* to a second, elevated temperature as during operation of the part. James et al. does not contain any teaching or suggestion directed at performing a second operation to induce compressive stresses at a second temperature. Therefore, Claim 6 of the present application is patentably distinguishable over James et al.

With respect to Claim 7, the Applicant submits that James et al. does not teach, either expressly or impliedly, every aspect of Claim 7. More specifically, James et al. does not teach or otherwise suggest the limitation of performing a first operation to induce deep compressive surface stress along a portion of the surface of a part and performing a second operation to induce more shallow compressive surface stresses along a portion of the surface of a part *where the first and second burnishing operations are performed with burnishing members having differing moduli of elasticity*.

In rejecting Claim 7, the Examiner has made specific references to James et al. However, these references are devoid of any reference, express, implied or inherent, to burnishing members with different moduli of elasticity. Further, James et al., taken in its entirety, does not contain any discussion of modulus of elasticity as applied to burnishing members or otherwise. As such, Claim 7 is patentably distinguishable over James et al.

as James et al. does not teach or suggest any limitation with respect to moduli of elasticity.

With respect to Claim 14, the Applicant submits that the cited reference, James et al., does not teach, either expressly or impliedly, every aspect of Claim 14. Of the various references cited by the Examiner in rejecting Claim 14, only col. 11, line 60 – col. 12, line 2 of James et al. makes specific reference to temperature. The reference to temperature at col. 11, line 60 – col. 12, line 2 does not teach or suggest performing a second operation at a second temperature, but is instead a reference to the physical properties possessed by a part burnished at one temperature and *exposed* to elevated temperature during service. James et al. does not contain any teaching or suggestion directed at performing a second operation to induce compressive stresses at a second temperature. Therefore, Claim 14 of the present application is patentably distinguishable over James et al.

2. Claim 11

The Examiner has rejected Claim 11 under 35 U.S.C. 102(a) as being anticipated by SU701777. Applicant respectfully disagrees. The '777 reference does not teach every aspect of the applicant's Claim 11, expressly or impliedly, nor is every aspect of Claim 11 inherent in the '777 reference.

The '777 reference does not teach, as the Examiner contends, the limitation of performing first and second burnishing operations *to induce first and second layers of compressive residual stress*, respectively, wherein the first burnishing operation is performed with a burnishing member of a first diameter and the second with a burnishing member having a second different diameter. Instead, the '777 teaching is limited to

performing a burnishing operation with balls of different **diameters to improve the surface finish** of the burnished article. There is no explicit or implied reference to burnishing to induce first and second layers of compressive residual stress.

Further, burnishing to improve surface finish does not necessarily yield compressive surface stresses as the Examiner's rejection implies. Burnishing may improve the surface finish of a part while leaving the part with tensile surface stresses that may be undesirable for applications where metal fatigue is a concern. Therefore, the cited reference does not disclose performing a first burnishing operation using a first burnishing member to induce a first layer of compressive stresses along a selected region of a part and performing a second burnishing operation using a second burnishing member to induce a second layer of compressive surface stresses along a selected region of the part. As such, Applicant's Claim 11 is patentably distinguishable from the '777 reference.

B. Examiner's Rejections Under 35 USC § 103

In establishing a prima facie case of obviousness, three criteria must be met:

- i. Some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; and
- ii. A reasonable expectation of success; and
- iii. The prior art reference (or references when combined) must teach or suggest all the claim limitations.

MPEP § 2143. The Examiner has not established a prima facie case of obviousness with respect to applicant's Claims 2 and 13.

1. Claim 2

The rejection of Claim 2 under 35 U.S.C. 103(a) as being unpatentable over James et al. in view of SU701777 is respectfully traversed.

The Examiner has rejected Claim 2 as being unpatentable over James et al. in view of SU701777. The Applicant restates the arguments made hereinabove with respect to independent Claim 1. Further, the Applicant respectfully submits that the combination of James et al. and '777 does not teach or suggest all of the claim limitations of applicants' Claim 2 and there is no suggestion or motivation in the cited references to combine or modify either reference to read on the Claims of the subject invention. As such, the Examiner has failed to establish a prima facie case of obviousness with respect to applicant's Claim 2.

A prima facie case of obviousness requires that the cited reference or combination of references teach or suggest all the limitations of the subject claim. The Examiner has acknowledged that James et al. does not teach the limitation of the first operation performed with an apparatus for inducing residual compressive stresses comprising a burnishing member having a first diameter and the second operation is performed with a burnishing member having a second diameter. The Applicant contends that all the limitations of Applicant's Claim 2, including those incorporated from Claim 1 are not found in either '777, James et al., or the combination thereof, as suggested by the Examiner.

The Applicant submits that while the '777 reference teaches using burnishing members having different diameters for improving the surface finish of a part, there is no showing that one skilled in the art would be motivated to combine the teachings of the '777 reference with the method of James et al. to arrive at the claimed invention. Even if

all of the elements of the claim are disclosed in the cited references, the claimed invention taken as a whole cannot be said to be obvious without some reason given in the prior art as to why one of ordinary skill would have been prompted to combine the teachings of the references to arrive at the claimed invention.

Applicant's Claim 1, from which Claim 2 depends, states that a first operation is performed to induce a deep compressive surface stress and that a second operation is performed to induce more shallow compressive surface stresses. The '777 reference does not teach the limitation of treating or burnishing a part to induce compressive surface stresses, either deep or shallow. Instead, the '777 reference is directed to treating a part to improve the surface finish. As noted above, treating to improve the surface finish need not include inducing compressive residual stress and may actually cause tensile residual stresses to develop in the part. Further, there is no teaching or suggestion in the '777 reference or James et al. of performing an operation to induce a deep compressive surface stress and performing a second operation to induce a more shallow layer of compressive surface stress. Therefore, the combination of references does not teach or suggest all the claim limitations of applicant's Claim 2.

In addition, the cited references do not contain any suggestion or motivation, either in the references themselves or in the knowledge generally available to one skilled in the art, to modify the reference or to combine references **and the Examiner has not provided any showing of such motivation or teaching**. Indeed, the Applicant respectfully submits, if anything, the James et al. reference teaches away from the subject invention as it is directed to improving the depth to which compressive residual stresses extend beneath the surface of a part while the subject invention is directed to improving

the magnitude of compressive residual stresses contained at the upper most layers of a part. As stated, the '777 reference does not teach or suggest introducing multiple layers of compressive residual stress in the surface of a part but is instead directed to improving the surface finish of the part. Indeed, using burnishing means effective to induce compressive residual stresses along the surface of a part may in some cases harm the final surface finish of a part. Finally, because neither reference contains any teaching, motivation or suggestion for performing a second operation, burnishing or otherwise, to induce a more shallow layer of compressive residual stress, and one reference actually teaches away from such a limitation, there could be no reasonable expectation of success in combining the references to read all the limitations of Claim 2. Therefore, this element of the prima facie case of obviousness has not been established with respect to applicant's Claim 2.

2. Claim 13

The rejection of Claim 13 under 35 U.S.C. 103(a) as being unpatentable over SU701777 in view of James et al. is respectfully traversed.

The Examiner has rejected Claim 13 as being unpatentable over SU701777 in view of James et al. The Applicant restates the arguments made hereinabove with respect to independent Claim 11. Further, the Applicant respectfully submits that the combination of the '777 reference with James et al. does not teach or suggest all of the claim limitations of applicants' Claim 13. There is no suggestion or motivation in the cited references, and the Examiner has provided no such suggestion or motivation, to combine or modify either reference to read on the Claims of the subject invention nor is

there any indication of a reasonable expectation of success. As such, the Examiner has failed to establish a prima facie case of obviousness with respect to applicant's Claim 13.

The Examiner has acknowledged that the '777 reference does not teach the limitation of the temperature of the surface of the part during the first burnishing operation is of a first temperature and the temperature of the surface of the part during the second burnishing operation is of a second, different temperature. The Applicant submits that James et al. does not supply the necessary teaching or suggestion as to any advantage for treating a part at two different treatment temperatures such as taught by the subject application.

The Examiner has cited col. 11, lines 57-66 of James et al. as teaching the limitation of performing first and second burnishing operations on the surface of a part, where the surface of the part is at a different temperature for each operation. Applicant asserts that col. 11, lines 57-66 of James et al. does not teach this limitation. The cited reference teaches that a burnished weld joint having a specified amount of cold work less than about 5% has improved properties when the weld joint is *exposed to elevated temperatures* and/or mechanical overload during service. More specifically, the cited reference states that a weld joint, and areas of the part adjacent to the weld joint, having compressive residual stresses induced therein with an amount of cold working less than 5%, and preferably less than 2%, will retain the compressive residual stress when the part is *exposed to elevated temperatures* and/or tensile or compressive overload. The James et al. reference does not teach or suggest that a "second burnishing operation is performed when the temperature of the surface is at temperature different than the first temperature"

but only recites the unique properties a part burnished at a single temperature has when *subjected to elevated temperatures.*

Claim 13 is patentably distinguishable over '777 in view of James et al. as Claim 13 of the subject invention teaches the additional limitation of a second burnishing operation conducted at a second, different temperature. This limitation is not found in either '777 or James et al. Therefore, the combination of '777 and James et al. does not teach or suggest all the limitations of Claim 13.

Further, neither James et al. nor the '777 reference contain any teaching, suggestion, or motivation to combine the references. In particular, neither reference teaches the limitation of a second burnishing operation performed at a second different temperature. What is more, neither reference teaches, suggests or offers any motivation that would indicate that burnishing at any temperature other than a first temperature would provide any benefit. Therefore, because the cited references contain no teaching, suggestion, or motivation to combine the references, the prima facie case of obviousness has not been met.

Finally, because neither of the cited references teaches or suggests the limitation of performing a second burnishing operation at a second different temperature, there could be no reasonable expectation of success in combining the references to read all the limitations of Claim 13. Therefore, this element of the prima facie case of obviousness has not been established with respect to applicant's Claim 13.

Because James et al. does not teach or suggest every limitation of Claim 13, and because neither of the cited references contains any suggestion or motivation to combine or a reasonable expectation of the success of such combination, applicant respectfully

submits that Claim 13 of the subject matter application is patentable over '777 in view of James et al.

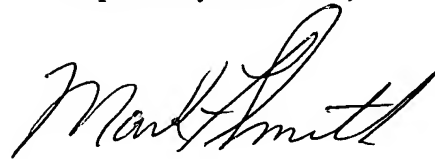
C. Examiner's Objections

1. Claim 12

Provided that the Examiner has found persuasive applicant's arguments in relation to Claim 11 from which Claim 12 depends, applicant respectfully submits that Claim 12 is in proper condition for allowance and requests that the Examiner rescind the objection to Claim 12.

In view of the foregoing Amendment and Remarks, Applicant respectfully requests reconsideration of the Application and that a timely Notice of Allowance be issued in this case.

Respectfully submitted,



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